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Survey of Spectacle Wear and Refractive Error Prevalence in USAF Pilots and Navigators

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ABSTRACT

A retrospective survey of 5000 active aircrew records was performed at 12 United States Air Force (USAF) bases to obtain information about the prevalence of spectacle wear and refractive error. The data revealed that 27.4% of pilots and 51.5% of navigators/weapons systems operators (Nav/WSO) required spectacles when flying. Of the spectacle-wearing pilots, 12.4% required bifocals. Myopia was the predominant refractive error and a relatively large percentage of aircrew members had astigmatism of 0.75 D or more, e.g., 33.1% of pilots. At the time of entry into the USAF, refractive error data were clustered around emmetropia with a definite skew toward hyperopia.

Key Words: *spectacles, refractive error, pilots, myopia,* astigmatism, USAF aircrew, prevalence of spectacle wear

Statistical information on the number of USAF aircrew members required to wear spectacles when flying is important but largely unknown. Cockpit environments and some life-support equipment in today's high-performance aircraft are often incompatible with spectacle-wearing aircrew. Thus, if the number of spectacle wearers becomes large, human factors design changes must be considered to provide for spectacle integration with life-support and combat target-acquisition equipment. Spectacle-wearing flyers can perform the mission,[1-3] but they do experience problems with reduced field of vision, discomfort, frame displacement from G-forces, lens fogging, and reflections at night. In addition, integrating spectacles with chemical defense equipment, night vision goggles, helmet-mounted sights, and laser/flash blindness protection can pose significant problems. Solutions to these problems include designing equipment to be compatible with spectacles, designing a new aircrew spectacle frame to be compatible with equipment, reinstituting more stringent vision standards, or fitting contact lenses in lieu of spectacles. Clearly, the recent interest in contact lens wear by aircrew members attests to the inherent problems with spectacle wear in flight.

In 1980, Provines et al.[4] conducted a survey which revealed that 20% of USAF pilots and 50% of USAF navigators were required to wear spectacles in the cockpit to correct their distance vision. Since then, the visual standards for aircrew selection have fluctuated. To update our aircrew information, we initiated a study at the USAF School of Aerospace Medicine (USAFSAM/NGO) to define the prevalence of spectacle wear and refractive error among USAF flyers. The data were collected by a team of vision scientists and optometric technicians who screened over 5000 flight medical records of pilots and Nav/WSO. Navigators and weapons systems operators were considered to be essentially synon-

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ymous in this study because they have the same vision standards and undergraduate flight training.

METHODS

A survey of flight medical records was performed at 12 USAF bases within 4 major commands (MAJCOMs). The MAJCOMs selected were Air Training Command (ATC), Tactical Air Command (TAC), Strategic Air Command (SAC), and Military Airlift Command (MAC). These 4 operational MAJCOMs contain 72% of the total population of all active USAF pilots and navigators. Bases were selected that had an active flying mission and possessed sufficient numbers of aircrew members to provide the data. An additional requirement was that the selected bases, when combined by MAJCOM, provided a balanced mix of flyers from each of the primary operational aircraft, e.g., within TAC, equivalent numbers of A-10, F-4, F-15, F-16, and F-111 pilots were obtained, and within MAC, an equal mixture of C-5, C-130, and C-141 aircrew members was achieved, etc. This served to eliminate any bias, in our sample of aircrew members, by type of aircraft flown. In addition, the Air Force's policy of regularly rotating aircrew assignments among bases world-wide prevented any geographical bias. The bases chosen were Beale, Bergstrom, Cannon, Carswell, Davis-Monthan, Eaker, Little Rock, Luke, Mather, Randolph, Travis, and Williams.

A team consisting of four optometrists, one ophthalmologist, and five optometry technicians collected the data. At least two team members, one of whom was a vision specialist, reviewed the records at each base. These data were manually transcribed on paper and subsequently entered into a computer. To simplify the complex task of retrieving refraction information from individual flight medical records, each team member was trained to collect data using standardized methods. Data were collected at each base on both pilots and Nav/WSO. The records of all active flyers ("A" flying status codes) in these two categories were reviewed. Flying personnel in nonflying staff jobs ("J" flying status codes) were not included.

The USAFSAM/NGO teams transcribed refractive data from the medical records at the following three milestones: entry on extended active duty (EAD) in the Air Force, entry into undergraduate pilot or navigator training (UPT or UNT); and the most recent annual examination. Additional recorded information included uncorrected visual acuity, age, bifocal wear, and entry mode into the Air Force, e.g., USAF Academy (USAFA), USAF Reserve Officer Training Corps (ROTC), and Officer Training School (OTS). Much of the descriptive information was available on the annual flight physical examination Standard Form 88 or Air Force Form 1466. However, to ensure accuracy the refractive error data were obtained from military eye examinations, which often required tedious tracing back through the aircrew medical records to obtain and verify a prescription. Due to the vast amount of information recorded, collated, and transcribed, on occasion some data were inadvertently lost. Therefore, the number of subjects may vary slightly at each milestone.

TABLE 1. Aircrew members requiring spectacles.[a]

MAJCOMs	Pilots	Nav/WSO
ATC	25.8%	51.1%
MAC	25.9%	49.2%
SAC	29.2%	51.3%
TAC	30.2%	54.8%
Total	27.4%	51.5%
N	3226	1634

[a] Differences between MAJCOMs were not statistically significant with χ^2 analysis at the $p = 0.05$ level. N, total number of aircrew members surveyed.

RESULTS

Prevalence of Spectacle Wear

The prevalence of spectacle wear data is displayed in Table 1, which lists the current percentages of aircrew members required to wear spectacles by flying category and MAJCOM. The overall percentages, which included both single vision and bifocal wearers, were as follows: pilots, 27.4%; Nav/WSO, 51.5%. Of those aircrew members required to wear spectacles, 12.4% of pilots and 2.4% of Nav/WSO were prescribed bifocals. Of the pilots sampled who wear bifocals, 72 of 110 (65%) also required spectacle correction for distance vision.

The current aircrew population for each MAJCOM is listed in Table 2, along with the respective sample sizes from our study. The total Air Force-wide population for each category appears at the bottom of the table. Except for those marked with an asterisk (*), the sample sizes were sufficient to satisfy the criterion of 95% confidence that the population data do not differ from our sample data by more than 5%. The asterisk-marked sample sizes have a ±7% accuracy with 95% confidence. The formulas used were from Cochran[5] for sampling from finite populations with variances conservatively estimated by assuming $p = 0.5$.

The data from ATC included many student pilots and navigators. However, student pilots and Nav/WSO were not included in the ATC population data. This explains why, in Table 2, the ATC pilot sample size was so large and the Nav/WSO sample size was even larger than the population.

Visual Acuity

Uncorrected distance visual acuities for pilots and Nav/WSO are shown in Table 3. Most pilots (79.8%) and over one-half of Nav/WSO (54.9%) had 6/6 (20/20) or better uncorrected visual acuity. Compared to pilots, there were more Nav/WSO who had reduced unaided visual acuity. This was especially true in the 6/30 (20/100) or worse cate-

TABLE 2. Populations and sample sizes by flying category.

MAJCOMs	Pilots			Nav/WSO		
	P[a]	S	%	P	S	%
ATC	3,430	1,298	37.8	652	765	117.0
MAC	5,438	619	11.4	1,513	177	11.7[b]
SAC	4,527	525	11.6	4,041	433	10.7
TAC	5,052	784	15.5	1,453	259	17.8[b]
Total	18,447	3,226	17.5	7,659	1,634	21.3
USAF total	25,603			10,583		

[a] P, population; S, sample size.
[b] ±7% accuracy with 95% confidence.

TABLE 3. Uncorrected visual acuity of pilots and Nav/WSO.

Current Examination (Visual Acuity)	Pilots		Nav/WSO	
	N[a]	%	N	%
6/6 (20/20) or better	2575	79.8	897	54.9
6/7.5 (20/25) and 6/9 (20/30)	259	8.0	152	9.3
6/12 (20/40) and 6/15 (20/50)	203	6.3	174	10.6
6/18 (20/60) and 6/24 (20/80)	118	3.7	175	10.7
6/30 (20/100) or worse	71	2.2	237	14.5
Total	3226	100.0	1635	100.0

[a] N, number of aircrew members; %, percentage of column total.

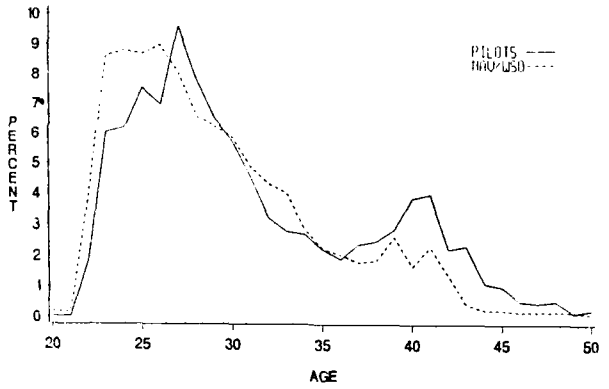

Figure 1. Distribution of ages in pilots (N = 3226) and Nav/WSO (N = 1634) from our samples as of June 15, 1988.

gory, which included only 2.2% of pilots but 14.5% of Nav/WSO.

Age

The distribution (frequency percentages) of age for pilots and Nav/WSO in our sample is shown in Fig. 1. The data from all four MAJCOMs were combined. The mean ages for the two categories were as follows: pilots, 31 years; Nav/WSO, 29 years. The range was from 21 to 55 years of age. Individuals 40 years of age or older comprised 16.5% of the pilots and 7.1% of the Nav/WSO. On average, the overall time in service for pilots was 10 years and for Nav/WSO, 7 years.

The age distribution of the total USAF population of actively flying pilots and Nav/WSO is displayed in Fig. 2, for comparison with our sample. The sample data in Fig. 1 are somewhat skewed to the left, unlike the population data, because some student pilots and Nav/WSO were included. After 25 years of age, the sample data are remarkably similar to the population data. The percentages of pilots and Nav/WSO in our sample who wear spectacles are grouped by age and shown in Figs. 3 and 4.

Current Refractive Data

The distribution of current refractive data for spectacle-wearing pilots and Nav/WSO is listed in Table 4. All data were taken from the manifest eye examination that was found to be most current by tracing back from the latest annual physical examination. Refractive error was represented by the spherical equivalent value (SPEQ) which is the sphere power plus ½ the cylinder power in diopters (D), e.g , plano −1.00 ×180 is a SPEQ of −0.50 D. Only data from the right eye were used because comparison of right and left eyes revealed no significant differences in SPEQ. These data showed that 80.5 and 91.7%, respectively, of spectacle-wearing pilots and Nav/WSO were myopic, i.e., have −0.12 D or more of SPEQ myopic refractive

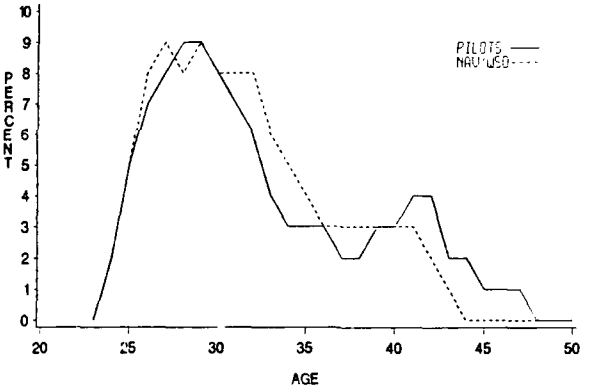

Figure 2. Distribution of ages in pilots (N = 18,026) and Nav/WSO (N = 6237) in the total USAF population as of December 31, 1988. (Sources are USAFMPC, Randolph AFB, Texas and USAFSAM/NG, Brooks AFB, Texas.)

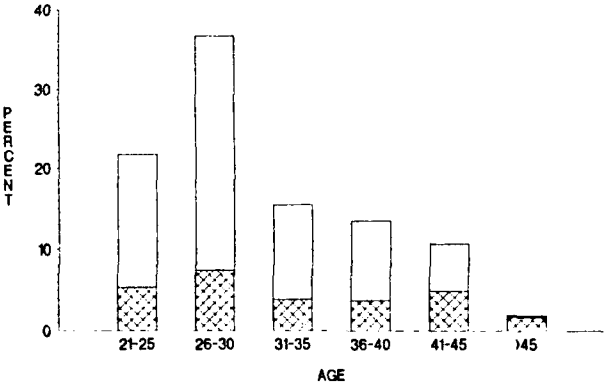

Figure 3. Prevalence of spectacle wear in pilots in each age group, and overall percentages of pilots in each age group (spectacles: Yes [×××]; No [——]).

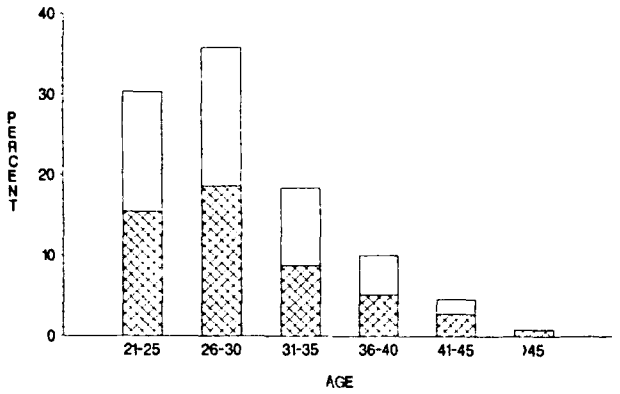

Figure 4. Prevalence of spectacle wear in Nav/WSO in each age group, and overall percentages of Nav/WSO in each age group (spectacles: Yes [×××]; No [——]).

TABLE 4. Refractive error in spectacle-wearing pilots and Nav/WSO.

Current Examination SPEQ (D)[a]	Pilots		Nav/WSO	
	N[b]	%	N	%
+4.00 or more	0	0.0	0	0.0
+3.00 to +3.88	0	0.0	1	0.1
+2.00 to +2.88	7	0.8	4	0.5
+1.00 to +1.88	36	4.1	12	1.4
plano to +0.88	129	14.6	53	6.3
−0.12 to −0.88	407	46.0	239	28.4
−1.00 to −1.88	252	28.5	311	37.0
−2.00 to −2.88	48	5.4	158	18.8
−3.00 to −3.88	4	0.4	49	5.8
−4.00 or more	2	0.2	14	1.7
Total	885	100.0	841	100.0

[a] SPEQ, spherical equivalent in diopters (D).
[b] N, number of aircrew members; %, percentage of total.

error. The mean values were −0.60 D for pilots and −1.30 D for Nav/WSO.

The frequency of astigmatic errors among aircrew members who wear spectacles is displayed in Table 5. These data show that 33.1% of pilots and 40.8% of Nav/WSO have astigmatism of 0.75 D or more. This amount of astigmatism has clinical and visual significance which will be addressed later.

Initial Refractive Data

The SPEQ refractive data for pilots and Nav/WSO at the time they entered the Air Force on EAD are shown in Table 6. The data were taken from the cycloplegic examination required at entry, per Air Force Regulation (AFR) 160-43.[6] The mean SPEQ values were +0.20 D for pilots and −0.30 D for Nav/WSO. These data included all pilots and all Nav/WSO, whereas the current SPEQ data in Table 4 included only spectacle-wearing aircrew members.

It is obvious that Nav/WSO were more likely to be myopic and to have higher levels of myopia than pilots. Until recently, the maximum allowable myopia for acceptance into UPT was −0.25 D, although waivers were often given liberally. Maximum allowable myopia for acceptance into UNT was −2.75 D.

TABLE 5. Astigmatism in spectacle-wearing pilots and Nav/WSO.

Astigmatism (D)	Pilots		Nav/WSO	
	N[a]	%	N	%
plano–0.50	592	66.9	498	59.2
0.75–1.25	252	28.5	254	30.2
1.50–2.00	37	4.2	70	8.3
more than 2.00	4	0.4	19	2.3
Total	885	100.0	841	100.0

[a] N, number of aircrew members; %, percentage of total.

TABLE 6. Refractive error in *all* pilots and Nav/WSO upon initial entry into the USAF.

Entry Examination SPEQ (D)[a]	Pilots		Nav/WSO	
	N[b]	%	N	%
+4.00 or more	0	0.0	1	0.1
+3.00 to +3.88	0	0.0	1	0.1
+2.00 to +2.88	12	0.4	11	0.7
+1.00 to +1.88	322	10.1	99	6.2
+0.12 to +0.88	1562	49.2	518	32.2
plano to −0.25	1003	31.6	405	25.2
−0.38 to −0.88	192	6.0	202	12.6
−1.00 to −1.88	79	2.5	264	16.4
−2.00 to −2.88	4	0.1	84	5.2
−3.00 to −3.88	2	0.1	18	1.1
−4.00 or more	0	0.0	4	0.2
Total	3176	100.0	1607	100.0

[a] SPEQ, spherical equivalent in diopters (D).
[b] N, number of aircrew members; %, percentage of total.

Changes Over Time

The percentages of pilots and Nav/WSO required to wear spectacles at initial entry on EAD, at entry into UPT or UNT, and at the present time are compared in Table 7. Note the almost 5-fold increase among pilots required to wear spectacles from entry to the present time (5.7 to 27.4%). The change in percentages for Nav/WSO was not nearly as dramatic (39.7 to 51.5%).

The initial refractive data are compared to the current refractive data for spectacle-wearing pilots and Nav/WSO in Figs. 5 and 6. These figures trace the gradual shift toward myopia in USAF aircrew. It is obvious that most of the pilots who now wear spectacles did not wear them when they entered the Air Force.

Spectacle Wear by Mode of Entry

Spectacle wear in pilots, segregated by mode of entry into the Air Force, is presented in Table 8. Those pilots who entered via the USAFA showed the largest incremental increase in spectacle wear from time of entry on EAD to the time they started UPT (8.6 to 33.3%). This trend was not found in similar groups who entered on EAD from AFROTC (4.8 to 7.7%) or OTS (4.7 to 7.5%). It also appears that the percentage of spectacle wearers was great-

TABLE 7. Pilots and Nav/WSO required to wear spectacles at major milestones.[a]

Milestones	Pilots		Nav/WSO	
	Ns/Nt[a]	%[b]	Ns/Nt	%
Entry on EAD	180/3143	5.7	631/1589	39.7
Entry into UPT/UNT	446/3000	14.9	705/1569	44.9
At present	885/3226	27.4	842/1634	51.5

[a] Ns, number required to wear spectacles; Nt, total number in survey.

[b] %, percentage of spectacle wearers out of total number of pilots or navigators.

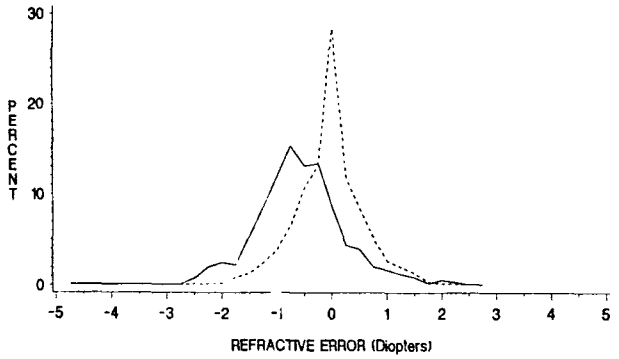

Figure 5. Distribution of SPEQ refractive error for only those pilots (N = 885) who wore spectacles at their initial entry on EAD (---) and at their most recent (——) eye examinations.

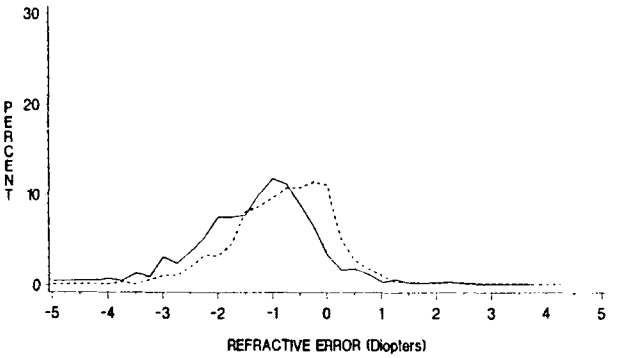

Figure 6. Distribution of SPEQ refractive error for only those Nav/WSO (N = 842) who wore spectacles at their initial entry on EAD (---) and at their most recent (——) eye examinations.

TABLE 8. Pilots by mode of entry who were required to wear spectacles at major milestones.[a]

Milestone	USAFA		AFROTC		OTS	
	Ns/Nt[b]	%[c]	Ns/Nt	%	Ns/Nt	%
Entry on EAD	74/861	8.6	57/1193	4.8	46/987	4.7
Entry into UPT	286/860	33.3	85/1109	7.7	69/925	7.5
At present	330/876	37.7	276/1203	22.9	244/1010	24.2

[a] Pilots who entered on EAD from modes other than USAFA, AFROTC, or OTS were not included.

[b] Ns, number required to wear spectacles; Nt, total number in survey.

[c] %, percentage of spectacle wearers out of total number of pilots.

est for USAFA pilots, at all three milestones, compared with AFROTC or OTS pilots.

Presently, pilots who are USAFA graduates have approximately a 14% higher incidence of spectacle wear than pilots who graduated from AFROTC or OTS.

DISCUSSION

Prevalence of Spectacle Wear

The most significant finding of this study is that 27.4% of pilots and 51.5% of Nav/WSO are required to wear spectacles when flying. Applying the percentages in Table 1 to the entire USAF aircrew population, as listed at the bottom of Table 2, an estimated 7015 pilots and 5450 Nav/WSO would be required to wear spectacles in flight. Thus, a total of 12,465 USAF aircrew members would require spectacle correction, which is over 34% of all pilots and Nav/WSO combined. Recall that these data apply only to active flyers. Aircrew members assigned to duties other than active flying, even though they may receive flight pay and must remain flight qualified, were excluded. Including nonactive flyers would surely increase the number of spectacle-wearing aircrew members, because many nonactive flyers are senior officers at or near the age of presbyopia. Also, a previous paper reported that over 40% of other aircrew members, which included enlisted flying personnel, nonrated flight officers, and flight surgeons, were spectacle wearers.[7] Therefore, the prevalence of spectacle wear in the USAF flying population is quite extensive.

Engineers, designing flight life-support equipment for flyers, must consider the fact that such a large proportion of aircrew members wear spectacles. Accordingly, spectacle compatibility should be incorporated into all aircraft and life-support equipment early in the design process. The previous practice of fielding new systems and then trying to adapt them retroactively to permit spectacle wear is neither efficient nor cost-effective.

Entrance visual standards for aircrew may need to be re-evaluated. Should we continue to allow so many spectacle wearers into USAF flying training programs when they will be constrained by the problem of wearing eyeglasses? The spectacle problems of fogging, weight, restricted field of view, discomfort, displacement, and reflections at night are potentially dangerous. On the other hand, it is difficult to believe that corrected refractive error poses any serious problem in flying, because spectacle-wearing aircrew members have consistently performed the mission.[1-3] However, spectacle incompatibility with flight gear can be a significant problem, especially for the single-seat fighter pilot with a complex, task-intensive job. Additionally, a considerable number of aircrew members are presbyopes who are required to wear bifocals when flying (12.4% of ametropic pilots). Wearing bifocals in the aerospace environment may create performance problems, e.g., the F-16 pilot with his head

tilted back in a 30° reclined seat, or the helicopter pilot who must look down and outside while the aircraft is hovering. Obviously, the presbyopic pilot is faced with some specific difficulties.[8]

Spectacle wear might be used as a criterion for initial aircraft assignment, i.e., spectacle wearers being assigned to multi-engine aircraft (bombers or tankers), and nonspectacle wearers being assigned to fighter aircraft. As Table 1 reveals, TAC currently has about the same percentage of pilots requiring spectacles as SAC, MAC, or ATC (the differences among MAJCOMs were not statistically significant with χ^2 analysis at the $p = 0.05$ level). Obviously, spectacle wear is not presently a consideration when making MAJCOM or aircraft assignments, and such a policy might be difficult to institute.[9]

The statistical information in this report regarding the prevalence of spectacle wear by aircrew members is important in planning optical logistic support. The military optical laboratories must be able to project workloads and manning levels and maintain an adequate stock of frames and lenses. In addition, these data are important for USAFSAM in its attempts to develop an improved aircrew spectacle frame for pilots that interfaces easily with life-support equipment and to provide optical support for spectacle-wearing aircrew members using night-vision goggles.

Recently, a new policy has been implemented that allows aircrew members to wear soft contact lenses instead of spectacles. Statistics on the prevalence and magnitude of refractive errors in USAF aircrew are essential to plan logistical support, professional time, increased manning requirements, and budgets for contact lenses and supplies. Major commands must have accurate information in order to plan flying schedules around contact lens fitting, adaptation, and follow-up care. They must also be aware of the incidence rates for ocular complications from contact lens wear in their aircrews. Otherwise, mission effectiveness rates may decline because of unexpected downtime.

Visual Acuity

The visual acuity results for pilots and Nav/WSO suggest that some flyers wear spectacles despite having 6/6 (20/20) or better uncorrected distance visual acuity. Extrapolating from the data in Table 3, only 20.2% of pilots and 45.1% of Nav/WSO have worse than 6/6 (20/20) uncorrected visual acuity; however, over 27% of pilots and 51% of Nav/WSO wear spectacles (Table 1). These differences are probably attributable to aircrew members with reduced near vision only (i.e., presbyopia with normal distance vision), monocular problems with 6/6 (20/20) in the better eye, or low myopic astigmatism that does not decrease visual acuity to worse than 6/6 (20/20). Visual acuity was found to be correlated poorly with refractive error in spectacle-wearing pilots and Nav/WSO combined ($r = 0.63$, Pearson correlation coefficient), which may reflect inconsistencies in visual acuity measurements obtained on routine vision screening. Also, some flyers with 6/6 (20/20) uncorrected visual acuity may elect to wear spectacles to achieve even better vision, e.g., 6/4.5 (20/15) or even 6/3 (20/10).[10]

Age

Visual inspection strongly suggests that the ages of aircrew members in our sample (Fig. 1) were representative of the USAF flying population (Fig. 2), the only exception being that the sample data included some younger student pilots and Nav/WSO. As expected, Figs. 3 and 4 showed that the prevalence of spectacle wear for pilots and Nav/WSO increases with age, especially past 40 years of age. However, no correlation was found between age and refractive error.[7] This is probably due to the fact that most myopic refractive error changes in aviators occur before UPT or UNT, or during the first 5 years after training.[11,12]

Current Refractive Data

Myopia is the predominant refractive error in spectacle-wearing aircrew members. A definite bias toward myopia is shown in Table 4 and is quite similar to the data from Provines et al.[4] In general, higher myopic corrections occurred in Nav/WSO, reflecting their less stringent entry visual standards.[6]

Categorizing refractive error by the amount of astigmatism is also important. Astigmatism of 0.75 D or more is visually significant when fitting soft contact lenses, when wearing night-vision goggles without spectacles, and when fabricating SPEQ spectacle lenses on the battlefield. Provines et al.[13] found in 1980 that 28.4% of spectacle-wearing pilots and navigators combined had 0.75 D or more of astigmatism, which is slightly less than our current data of 33.1% in pilots and 40.8% in Nav/WSO (Table 5). As an aside, we looked at the correlation between the amount of astigmatism (cylinder) and the magnitude of spherical refractive error. These two parameters were found to be independent (Fig. 7), but our sample may be biased because entry

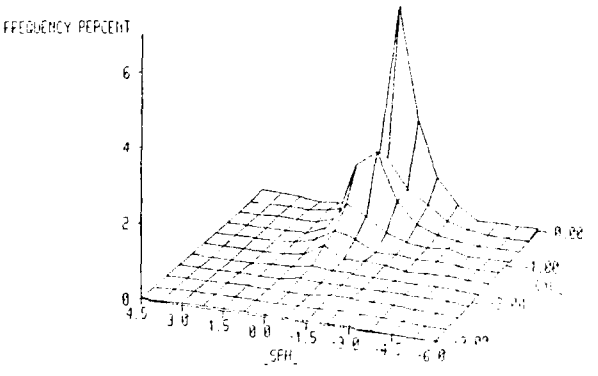

Figure 7. Distribution of cylindrical vs. spherical refractive error in pilots and Nav/WSO combined.

refraction standards restrict the amount of astigmatism.

Initial Refractive Data

The initial SPEQ refractive error for all pilots and Nav/WSO at entry on EAD is also similar to that found earlier in other studies.[3,4,11,12] Our data for pilots and Nav/WSO show a tight clustering (leptokurtosis) around emmetropia, with a definite hyperopic skew, although Nav/WSO have a myopic tail. Extrapolating from Table 6, 8.7% of pilots had more than −0.25 D of myopia at the time of entry on EAD. However, the visual standards for UPT require each candidate to have no more than −0.25 D of myopia. Thus, at least 8.7% of pilot candidates had to be given waivers for excessive myopia at the time they entered on EAD. Somewhat contradictory information is shown in Table 7, because only 5.7% of pilots were actually required to wear spectacles when they entered on EAD. These data may reflect oversights in the initial entry physical examination process. Although waivers for myopia were being granted at that time, spectacles were not prescribed, when indicated, for some pilot candidates with low myopia.

Changes Over Time

There are dramatic and consistent increases in the percentages of pilots and Nav/WSO required to wear spectacles over the course of their USAF careers. Of those pilots who currently wear spectacles, only 17.6% wore them at the time of initial entry on EAD. There is also a large change in the data for pilots from entry on EAD to UPT entry, in spite of the fact that the elapsed time from initial entry on EAD to flight training is only 1 to 3 years for most pilots. The most probable explanation is that this is the time of life during the late teens or early twenties when myopic changes often occur, i.e., the college years.[7,11,12,14-16]

The move toward myopia in pilots and Nav/WSO is also very obvious in Figs. 5 and 6. The implications of this trend for predictive value and setting visual standards will be addressed in another paper.

Spectacle Wear by Mode of Entry

Pilots who enter on EAD from the USAFA have greater incidences of spectacle wear at each milestone than pilots from AFROTC or OTS. The refractive changes which occur in the approximately 3 years between entry into the USAFA and entry into UPT are especially dramatic (8.6 to 33.3%). O'Neal and Connon, who earlier noted this myopic shift at the USAFA,[11,12] found that 25% of entering emmetropes (cycloplegic refraction SPEQ of +0.12 to −0.12 D) needed spectacles at graduation. They concluded that emmetropic 17- to 21-year-old cadets were not immune from developing myopia, particularly during an intensive educational program.

Why were larger changes found in pilots who entered on EAD via the USAFA as compared to other modes of entry? A plausible explanation is that new cadets at the USAFA were younger than individuals who enter on EAD via AFROTC and OTS, and more time elapsed between their entry and flying training. Our data revealed that the mean ages for pilots at time of entry on EAD were 17.5 years of age for the USAFA, 21.2 years for AFROTC, and 22.5 years for OTS. The mean ages for pilots at their training examination were 21.6 years for the USAFA, 22.6 years for AFROTC, and 23.6 years for OTS. Also, waivers were often given to USAFA cadets with myopia at the time they entered UPT so that they could be retained for pilot training.

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